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Fall Changes

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Fall Changes

By Eva L. Gordon, Richard B. Fischer, and Verne N. Rockcastle

Ever since school opened you probably have been noticing and studying fall changes. Probably, too, you have made changes yourself in the things you do and the ways and times you do them because it is no longer summer. You do different kinds of work, and you do different things for fun than you did. The days are shorter and the nights are longer than they were in June or July. Week by week the weather has grown cooler, until now you are glad to wear warmer clothes and to have heat at home and in school.

Even before autumn 1954 began officially on September 23, signs of the season had begun to appear. People were busy with fall activities. Many of these were preparations for the winter to come. How many things can you list that people do in autumn to get ready for winter? What did you do in autumn 1954?

Plants and animals other than human beings probably do not plan for the coming winter as we do. But many fall activities and changes among New York State plants and animals help them to survive severe winter weather. You may have watched some of these changes, and even kept records of what happened.

Did you notice when the leaves on trees and shrubs began to show red, yellow, and purple colors? It was long before we had frost, wasn't it? Did any plants not trees or shrubs show similar changes in color?

Did you study fruits and seeds? how they are scattered? what animals eat which seeds or fruits?

Snowy Tree Crickets
The male (below) is an important part of the fall insect chorus.

Did you discover buds on trees and shrubs, early in the fall, already packed with next year's leaves, flowers, and twigs?

Did you watch leaves fall?

Did you enjoy the fall flowers —the asters, the goldenrods, Joe-Pye-weed, white snakeroot, and others that showed their blue, yellow, purple, and white colors along roadsides, in fields, and beside streams and ponds? Did you see many red wild flowers? Did you learn to know some fall garden flowers you had not met before? Did you find witch-hazel in blossom, the only native woody plant that regularly blooms in the fall in New York State? Did you find puffballs and other fungi? Many kinds grow in late summer and early fall. We found circles of white ones that made fairy rings in the lawn.

Did you hear the nightly insect chorus, and notice that the fiddlers and scrapers played more slowly on cool nights than on warm ones? Did you capture a grasshopper, a cricket or two, or a katydid and watch him play his part in the insect orchestra?

Did you realize that frogs, toads, snakes, and earthworms quietly departed to winter quarters as the weather became colder?

Did you have an opportunity to watch a chipmunk or a squirrel gather and store part of its winter food supply?

Have you seen a southbound flock of wild geese? or, even earlier, a flock of blackbirds, or of swallows?

Did you record the first heavy frost? the first snowfall?

Did you help remove screens and put on storm windows or do something else to make your home ready for winter?

Have you needed mittens?

Do you know how much later the sun rises now than it did in July? how much earlier it sets?

All these and many more changes and special activities take place in autumn, especially where, as in New York State, the four seasons are distinctly different from each other, and one of them is a cold winter.

Suppose you list the fall changes you have noticed in earth and sky; among the plants; and in the behavior of animals. Then, let us try to picture as well as we can, how different kinds of plants and animals have met the autumn changes in their environment: where they are, and how they are fitted to survive the winter that begins officially when fall ends, on December 22, the shortest day of the year.

On October 27 the sun set almost at the center of this horizon. Would it set farther to the right or to the left as fall progresses?

Earth and Sky

Weather and Climate

You probably had to turn on the lights for supper last night, didn't you? And after supper you didn't go outdoors to play ball as you did last summer. Night comes early now, and the days are shorter and cooler than they were when school began.

These same changes take place each fall as the earth (with you on it) revolves around the sun. A year is the time it takes for the earth to make this long journey. As it travels, the earth's axis always points toward the North Star. This is the cause of our four seasons. It points our northern hemisphere toward the sun in our summer and away from it in our winter. It causes the days or nights to grow longer or shorter as the seasons change. It makes the sun seem to rise and set in different places in winter and summer, in spring and fall.

To see this last change, pick out a tree, a building, or some other easy-to-see marker on the horizon close to where the sun rises or sets. Each week or two check with your marker to see whether the sun rises or sets at the same place. What do you observe? Does the sun's position seem to move northward or southward from the marker? By studying some of your books or *Sky Laboratories,* the Leaflet for Winter 1952-53, you can probably learn why the place of sunrise and sunset seems to change from season to season.

The table on page 6 gives the length of day and night at

weekly intervals through the fall. Can you tell about how long today and tonight will be? You may wish to find out when the sun rises and sets at your home. Some almanacs have tables that will tell you, or your local newspapers may give the information. "Sunrise" in almanacs means the time when you can first see the edge of the sun. "Sunset" means the time when the last bit of the sun disappears. So the times in the almanacs will be a little different from those in the table.

Length of Day and Night at New York City in Fall

		Day		Night	
		Hrs	*Mins*	*Hrs*	*Mins*
Sept.	22	12	0	12	0
	29	11	42	12	18
Oct.	6	11	23	12	37
	13	11	4	12	56
	20	10	47	13	13
	27	10	29	13	31
Nov.	3	10	13	13	47
	10	9	57	14	3
	17	9	42	14	18
	24	9	30	14	30
Dec.	1	9	19	14	41
	8	9	12	14	48
	15	9	7	14	53
	22	9	6	14	54
	29				

Can you fill in the blank spaces for December 29?

In fall and winter the sun's rays do not strike our part of the earth as directly as they did in summer. Until December 22, they become more and more slanting. Slanting rays bring less heat to each square mile. The diagram on page 7 will help you understand why.

If one of your classroom windows faces toward the south, you can easily see for yourself how the height of the sun in the sky changes and its rays become more (or less) slanting. Tape a white card to the window casing of your south window as shown on page 8. Then tape a piece of wire or a knitting needle to the window so that its noonday shadow falls on the card. Each sunny day *at noon* mark the location of the shadow. At the end of a week which way has the shadow moved? If you make your first study in early December, you may be surprised to see what happens to the shadow if you continue your record through January.

The lowering of the sun in our fall sky produces noticeable changes in the weather. Early in the fall you probably noticed how heavy the dew was in the

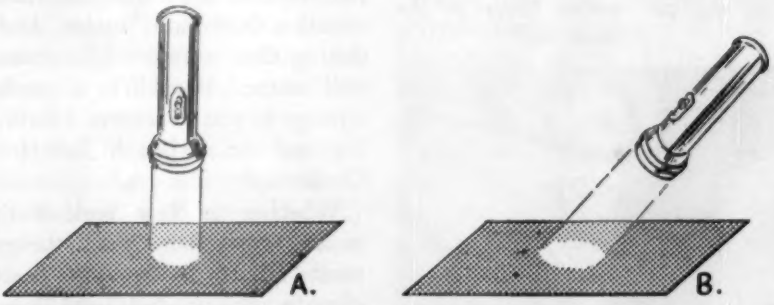
morning. Then morning frost appeared instead of morning dew. Frosts grew heavier as fall passed. The first snowfall came. Then snow fell more often than rain. Perhaps today the ground where you live is covered with a white blanket.

Although the days steadily grew shorter as the sun moved lower into the southern sky, the air and the land did not cool so steadily. Sometimes cold air from Canada arrived over New York, and sometimes warm air moved up from the south. So we had cold days and then warm days. But through the season, the air from the south grew cooler and the Canadian air grew colder.

If a thermometer is outside the window of your room, you can see how the temperature changes from day to day and from season to season. Keep a record of the temperature reading for each day *at the same hour*. During a month you will probably see that some days are warmer than others, but in general the temperature drops throughout the fall and much of the winter. Perhaps you can record the temperatures in the form of a graph. Ask your teacher to help you.

Because the autumn sun is even lower in the southern sky in Canada than it is in New York State, cold weather comes to Canadians before it does to us. There, plants and animals start their fall changes before ours do. Trees there shed their leaves a little earlier, animals hibernate a little sooner, and frost and snow usually come earlier. How does fall in the Southern States compare with fall in New York State?

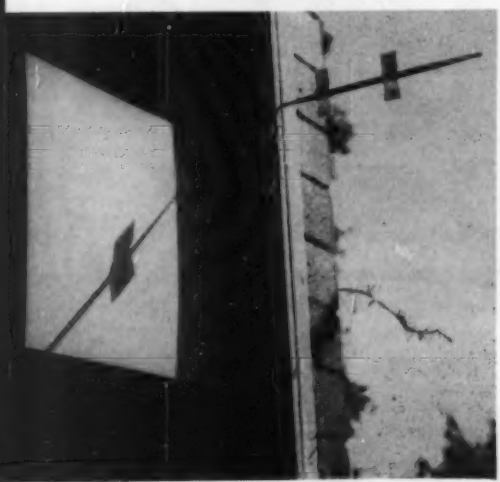
You may ask why these changes take place. You know that the earth receives heat from



Slanting rays spread over a larger area than do direct rays

the sun during the day and loses heat at night. When days are short, the earth does not warm much during the daytime, but it cools greatly during the long nights. Why, then, do we usually have our hottest weather in July and August, and our coldest weather in January and February, although June 22 is the longest day of our year, and December 22 the shortest? The sun radiates heat to the earth only during the day. The earth radiates heat into space *both* day and night. On June 22 we get more hours of heat from the sun than on any other day in the year. For a few weeks in summer our part of the earth receives its greatest amount of heat from the sun. But the earth has been cool and warms gradually. So, our highest summertime temperatures come a month or so *after* the longest day of the year. Our warmest days usually are about halfway between June 22 and September 22.

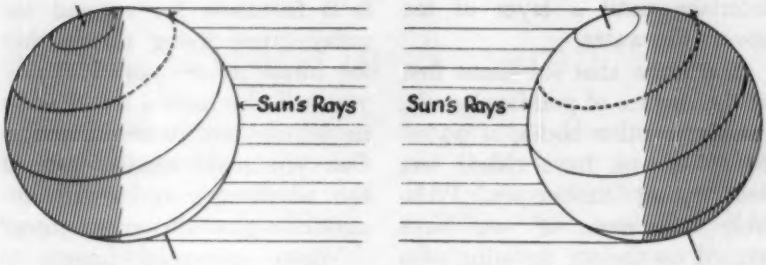
Which way will the shadow move as the sun moves lower in the autumn sky?



In the fall we receive less and less heat from the sun, and our part of the earth constantly loses heat. In the northern hemisphere our stored heat grows less and less, but does not reach its lowest point until well after the shortest day of the year. The earth *cools* gradually, too, and it takes an extra month or so to use the heat stored during the summer. So, our coldest days are about halfway between December 22 and March 22.

When our northern hemisphere is tilted away from the sun and our nights are longer than our days, what is it like in South America? Your school year begins in September, but in Argentina and Chile the school year ends during our fall months —their springtime. In South America, Australia, and Africa the children have their summer vacation during our winter. And during their summer Christmas will come. Wouldn't it seem strange to you to receive a bathing suit or a beach ball for Christmas?

Whether in New York State or in Australia, living things must adjust to weather and climate. Every day most persons make some adjustment to



As the earth makes one turn in June, will x be in sunlight or in darkness more of the time? In December?

the weather. So do many other living things. Some just endure the changes as they come. In much the same way living things, especially in climates like that of New York State, adapt to the greater changes brought by the changing seasons.

Soil and Water

Probably before this Leaflet reaches you, you will have discovered, some cold morning, that the top layer of soil near your home or school sparkled with ice, and had frozen into a solid crust. What other fall changes in land and water can you list now?

Have you noticed which freezes sooner—and deeper—bare ground or soil covered with leaves or snow or something else? Which thaws first in warm weather? Does the frozen crust of the soil become thicker as the season progresses into winter?

Perhaps you have put a tightly corked bottle filled with water out-of-doors in freezing weather and watched the water become ice. Then you know that water *expands* when it freezes. As water in freezing soil expands, it may lift stones, or plants, or even buildings if their foundations are not deep enough. Water freezing in cracks in rocks helps to break them, and thus to hasten the process of making rock into soil.

Have you ever watched ice crystals form on water? If you haven't, you might like to fill a large pan with snow or ice mixed with salt. Press a small, shallow tin into the mixture, partly fill the tin with cold water, cover it with a piece of glass, and allow it to stand. Needle-like ice crystals should soon form on the surface of the water. Watch them enlarge and

interlace until a layer of ice covers the water.

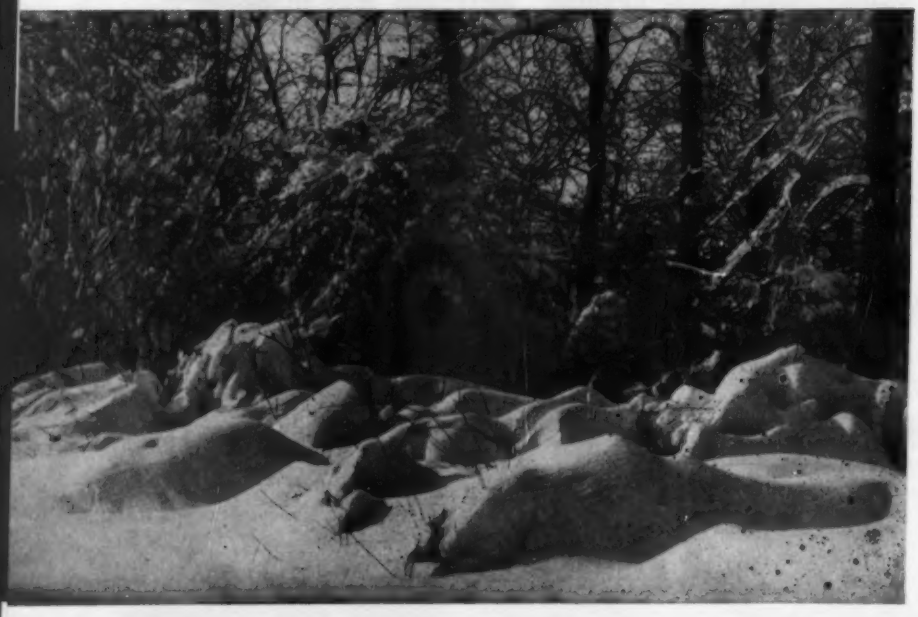
You know that ice forms first at the surface of puddles, ponds, brooks, or other bodies of water. Many of you have risked wet feet testing "rubber ice." Probably still more of you have skated on the icy covering of a pond or a lake. You know that unfrozen water usually is beneath the ice of all but the smallest and shallowest bodies of water.

Did you ever stop to think how different things would be if ice regularly formed first at the bottom of bodies of water and remained there? When you have finished working with the Leaflet, you will, I believe, be able to give many reasons why it is fortunate for us and for many other living things that ice forms as it does. Probably you will also have a list of ways in which ice causes damage. Can you make similar lists of the advantages and disadvantages of a ground cover of snow?

Water ordinarily changes to ice when its temperature falls below 32° F. Some of you may wish to take the temperature of water under the ice of a pond or stream, and to investigate the reasons for what you discover. Science teachers can help or can tell you where to find out.

Changes in soil and water caused by changes in climate affect most plants and many animals, as you will see in the following pages.

A thick blanket of snow protects many plants and animals



Plants in Autumn

In your science class, review and list what plants need to make them grow well; or read or experiment to find out. Then, compare what you find with conditions outdoors in New York State in late fall. The hours of sunlight have decreased (from about 15 on the longest day of the year to about 9, on December 22, the shortest day). Through the fall, temperatures have dropped lower and lower. Often by the end of the season, the surface soil and the water in it are frozen. Ice shows on ponds and streams. Snow may cover the ground. Short days, cold weather, ice, and snow continue through much of the winter. Do you wonder that the growing season for most plants ends during the autumn months and does not begin again until spring has come?

Plants of different kinds make different changes as the autumn months pass. If you made the list suggested on page 4, you probably have thought of many of these changes. Visits to nearby parks, gardens, flower beds, roadsides, vacant lots, or other places where plants grow may help you to learn more about the changes you have noticed, and perhaps to discover others. I believe you will find that plants meet fall changes in climate in two main ways. Some kinds die, but their seeds remain alive, ready to become new plants of their kind when they can. Other kinds of plants remain alive—they may have produced seeds, too. Most such plants become less and less active as fall progresses. They may lose their leaves, die down to the ground, or otherwise change their appearance.

We do not believe that plants prepare for winter as we do. But each fall each kind makes the same kind of changes. When their changes are finished usually they (1) are able to live through the winter, and (2) are ready to start growth again as soon as conditions are favorable.

Annuals, Biennials, and Perennials

Many of the flowering plants that die during autumn or are killed by fall frosts are *annuals*. They develop from seeds, grow, blossom, produce seeds, and die, within a single year, most

of them during a single growing season. The marigolds and zinnias whose leaves blackened and died after the first hard frost belong to this group. So do garden peas and beans, and many garden weeds. Can you add other plants to this list?

Biennials require two years in which to grow from seed and produce seed themselves. Beets and carrots, mullein and Canterbury bells are examples. They start from seed and make part of their growth during their first season, then live through a winter, blossom, produce seeds, and die during their second summer and fall.

Plants that normally live for a number of years (some only for a few years, others for a great many) are known as *perennials*. Trees, shrubs, goldenrods, rhubarb, and many other common plants are perennials. Some, such as maple trees, must grow for several years before they can produce their first crop of seeds, but after they are mature they produce seeds year after year.

Rosette of Common Mullein. The hairy leaves often shelter hibernating insects in winter

Plants that live through New York State winters usually are biennials or perennials. A few kinds of plants, mainly weeds, may start to grow from seed in late summer or early fall, make part of their growth before cold weather comes, and finish their life the next summer. Botanists call them *winter annuals*. Shepherd's-purse is an example.

Green Plants Make and Store Food

During the long, warm days of late spring and early summer, when water usually is plentiful, green plants make food rapidly. Some of this food they use immediately for growth, or to produce flowers and seeds. Some they store in various plant parts: roots and other underground parts; fruits and seeds; leaves; and stems (which may be above ground or underground). Annuals store food only in their seeds. Can you think why?

In late autumn, winter, and early spring, conditions for food-making are poor in New York State. Temperatures are low, and days are short. Plants

Living parts at the base of some of these familiar plants are dormant through the winter. Roots of others die

use much water when they are actively making food. The time usually comes in fall or winter when much of the available water supply is frozen. So during the colder months, plants make less and less food; some stop completely.

When good growing conditions return, food stored in seeds is used to start seedlings. Food stored in other plant parts that have lived through the winter serves to start new growth. Trees and shrubs put out new leaves and flowers on new twigs. A carrot left in the garden over winter sends up new leaves, blossoms, and produces seeds. The carrot will shrivel as the new parts use the stored food. Trees, shrubs, and many other plants soon are able to make enough food for growth and to replenish their stores.

You might like to prepare an exhibit to show where food is stored in different kinds of plants, and how the food stores differ. I am sure you will think of other ways these foods are used than just to start new plant growth.

Dormant Plants

Your dictionary will tell you that *dormant* means *inactive.* Most plants that live through New York State winters have become more or less dormant by late fall. Many have changed greatly, and they have changed in different ways. Some have lost their leaves. Some have

died down to the ground. They remain largely inactive through the winter, but most are ready to start growth immediately as soon as spring weather comes.

Dormant plants are all around you. How many different ways can you find in which living plants have adjusted to the colder seasons by becoming dormant?

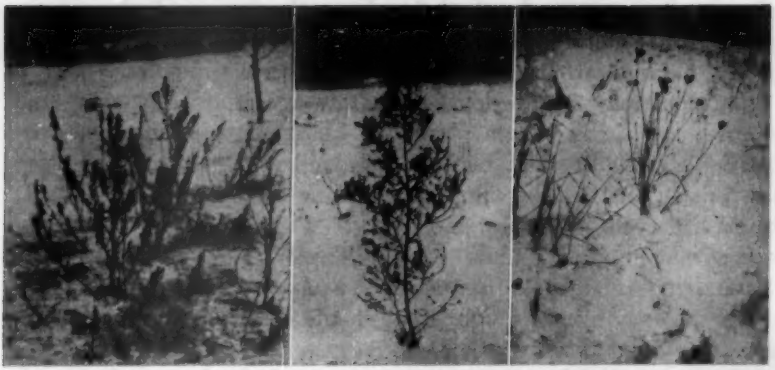
Can you find plants that are green, much as they were in summer? Probably you will think first of pines, spruces, hemlocks, and other kinds of trees and shrubs you call *evergreen.* How many "evergreens" with needle-like leaves can you find? with scale-like leaves, such as those of arbor vitae? with broad leaves, such as those of the laurels? Many kinds of woody plants–plants with woody stems that do not die down to the ground in winter–are evergreen. Don't forget to look for small evergreen woody plants, such as partridge-berry, trailing arbutus, or wintergreen. Can you find proof that some leaves have fallen, even from evergreens?

Some kinds of ferns are evergreen, too. What about the mosses? and the tiny gray-green lichens? and the low, creeping plants you may call *ground pine* or *club moss*? (The ground pines generally need conservation–they grow slowly; 25 years or even more may be required to grow enough for one Christmas wreath.)

Hepaticas and some other kinds of woodland flowering plants have green leaves all winter. Evening primrose, teasel, and some other biennials produce, during their first summer, rosettes of leaves that hug the ground all winter, forming green patches in fields, gardens, and such places. Dandelions, some thistles, dock, and other plants also have winter rosettes. Some garden flowers show green leaves during the winter.

You will find many green plants under the snow, in sheltered places, and even in some open spots. You may even find some plants in bloom in almost any month in late fall, winter, or early spring. You would be surprised at the number of kinds of flowers your class might find in bloom outdoors at Thanksgiving time by careful searching in different kinds of places. I know–my classes have often tried it.

As you examine these plants that remain green, but are usually dormant, notice how many have small leaves, or thick, tough leaves, or waxy or hairy leaves. How many grow where



Redroot Pigweed (left) and Lamb's Quarters (center) are annuals; Queen Anne's Lace (right), a biennial. All three bear many seeds; those of the two annuals are winter foods of many birds. Which plants would have dead roots?

they are usually well protected by fallen leaves, by snow, by a building, or in some other way?

Some kinds of plants lose all or most of their leaves in autumn. Most of you can make a long list of plants that belong in this group. You will recall the bright fall colors of their leaves, and the fall days when the leaves whirled or drifted to the ground. Most of these plants are trees, shrubs, or vines—woody plants—aren't they? Their strong stems usually can withstand winter weather, and their tough bark is good protection. Even the places where the leaves broke off are covered with a corky layer called a *leaf scar*. These leaf scars differ in different kinds of woody plants, and serve as good clues to identify them. *Woodlands in Spring*, the Leaflet for Spring 1954 tells more about this.

Can you think of ways in which losing leaves in fall might benefit these plants? See what your textbooks have to say about this, and ask your teacher to tell you about the article on leaf-fall in the Fall 1953 Teachers' Number of the Leaflet.

Dead plant tops are worth examining. Have you ever noticed the variety and the beauty of weed tops above a fresh blanket of snow? If you haven't, watch roadsides, vacant lots, old fields, and similar places this winter.

Some of the plants you see may be dead from their topmost

tips to the very ends of their roots. But when you disturb them to find whether this is true, you may shake loose a shower of seeds. Such plants may be annuals; they may be biennials that have finished their life cycle; or, more rarely, they may be perennials that have died. Annuals, you remember, do not live through the winter. Only their seeds live, dormant, but ready to start new plants the next spring.

When you dig around the base of other dead plant tops, you soon discover that they are alive below ground. Food has been stored in their underground parts, and from them new growth will come when growing conditions are good again. Rhubarb, asparagus, many kinds of grass, and many garden and woodland plants are examples. How many such plants can you find? You noticed that many of their dead tops, too, still held seeds, didn't you? Seeds can start new plants; living underground parts enable old plants to grow again another year.

You know that the tops of many plants die and disappear even before fall begins. Leaves of Dutchman's breeches are difficult to find by midsummer. But if you know what to look for and where to look, you can find the underground parts, alive and waiting until time to grow again.

Plants have their own times as well as their own ways of adjusting to winter.

Buds for Next Year's Growth

Probably you noticed, early in the fall, that winter buds for next year's growth showed on trees and shrubs even before the leaves had changed color and fallen. On most woody plants these buds started to grow early in the summer and were fully formed by the middle of September. You know, of course, what winter buds are. They contain the tiny beginnings of next year's twigs and leaves, and sometimes the beginnings of flowers as well. *Woodlands in Spring* (the Leaflet for Spring 1954) told you a little about them, and suggested some things you could do to help you learn more. Textbooks and other references will help, too.

These buds are dormant during the winter. But they are ready to develop rapidly when spring weather comes. Try to force some to grow now, in water in your warm schoolroom. You may be successful with some kinds; others will not develop until later when it is near-

er time for them to grow outdoors.

Woody plants are not the only ones that have winter buds for the next spring's growth all ready and waiting before fall ends. On October 15 rhubarb buds (containing miniature leaves and blossom stalks, ready to grow next spring) showed in my garden. Buds, from which next spring's hepatica blossoms and new leaves will come, were easy to see, nestled at the center of the cluster of 1954 leaves. The underground parts of peonies showed where next year's shoots will grow. The "eyes" of the potatoes we cooked for dinner held small buds from which sprouts or new potato plants might have grown. You will have fun, I think, discovering and comparing buds on different kinds of plants all ready for spring growth.

Flowers, Fruits, Seeds, and Spores

What fall flowers do you remember seeing in the month or so after school began and before hard frost came? Asters of many kinds? goldenrods? hawkweed? dandelions? garden flowers? witch-hazel? Did you watch some of these kinds of flowers fade, and their fruits and seeds develop, ripen, and depart from the plant? Did some of you watch cucumbers grow where yellow cucumber flowers had been, and were you surprised to see how soon they, with their seeds, could ripen? Did you see witch-hazel shooting seeds that developed from 1953 flowers at the same time the 1954 blossoms were in bloom? Have you noticed since that the yellow petals have fallen, but that parts of the flowers remain? These parts will grow next summer into tough woody fruits about ½ inch long, that will shoot out their shiny

Hurricane Hazel exposed this hoard of acorns probably gathered by an Ithaca red squirrel

Spore-bearing Fronds of Sensitive Fern

black seeds in the fall of 1955.

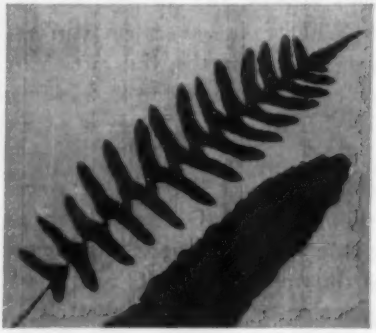
Fruits have developed and seeds have ripened on various kinds of plants since early in the spring. But fall is the great seed-time of the year. Probably you had science lessons in September or October about fruits and seeds: what they are; how and where they are produced; how they differ. Perhaps you observed how seeds are scattered. You may have noticed that many plants produce enormous numbers of seeds, far more than could find places or room to grow.

How many kinds of seeds or fruits can you find now, still on the plants on which they grew? Look into trees and shrubs. Check weeds and other plants. How many kinds can you find on the ground? Can you find some seeds that have sprouted? Can you find many young seedlings?

Most of the seeds that are ripened and scattered in the fall do not begin to grow until spring. Is that true of white-oak seeds? of other kinds of acorns? Some kinds of seeds—horse-chestnut is one—will not germinate until they have been frozen. You might like to gather several kinds of seeds and plant them in the schoolroom to watch which grow and which do not, and to learn how some kinds of seedlings look.

Ferns, mosses, various kinds of fungi, and some other kinds of plants do not produce seeds, but develop spores instead. Probably many of you have squeezed a cloud of dark, powder-like spores from a puffball; or have noticed the small, brown, dot-like

Rock-polypody bears its spores in round fruit-dots or sori (singular, sorus) on its evergreen fronds. Below, a pinna enlarged



patches on the underside of some fern fronds, in which their spores develop. Many spore-bearing plants shed spores in the fall; others hold them through all or part of the winter. Spores are not much like seeds except that they, too, can develop into new plants. Look in your textbooks and other references for more information about spores and the kinds of plants that grow from and produce them.

Plants and Animals

If some of you have gone outdoors to look at plants ready for winter, you probably know very well that you are not the only animals interested in them. Perhaps you saw a rabbit rush out of a hollow near a dead grass clump or in a brushy tangle. Plants furnish winter shelter to animals of many kinds. How many plant shelters can you think of or discover? Don't forget the layer of fallen leaves, dead branches, bark and such things on the ground; nor decaying logs. What animals can you list that find protection from winter weather in or among plants, even in places as small as a mullein seed pod?

Perhaps you discovered bird tracks around a seed-filled weed top; squirrel tracks under nut trees; young branches nipped off trees or shrubs, or bark nibbled. These and many other signs show that many animals depend on plants for winter food.

And how about yourselves? How do fall changes among plants affect you?

This chipmunk carried many fallen leaves into its burrow, for winter bedding

Animals in Autumn

IN the fall we in New York State plan for warm winter clothes. We "winterize" houses and cars. We harvest and store away foods (how many were produced by plants?) for ourselves and for our domestic animals. We put away summer things, such as lawn mowers and swimming suits, and get out snow shovels, skis, and skates. We take tender plants indoors or protect them out-of-doors. Some persons move to warmer climates to escape our northern winter. You can, I am sure, make a much longer list than this of things New Yorkers do to get ready for winter.

Probably other animals do not know, as we know, that winter follows fall. But most of them, some long before fall starts, begin activities that fit them for life in winter. When winter comes, they usually are ready for it, each kind in its own way.

Many animals live in much the same places and in much the same ways, winter and summer. We may not see much of them when snow lies deep in woods and fields, but a bird call, a nibbled nut, or a track in the snow betray their presence. Such animals are able to survive and to remain active through the winter because they are adapted (fitted) for life in regions where seasons change as ours do.

Other kinds of animals move to warmer climates—*migrate*, we say. You know that most of our summer birds have departed for their winter homes by November. Did you know that other animals also migrate? Several kinds of bats, and at least one insect (the monarch butterfly) may travel considerable distances. Some birds make a southward journey of thousands of miles. But other animals may find their "warmer climates" only a short distance from their summer haunts. A woodchuck in fall may descend 3 or 4 feet to below the frost line. An earthworm may burrow a foot or two deeper in the soil of your garden. The sunfish you tried to catch last summer may move from the shoreline to deeper water. Insects and some spiders may descend to low bushes, weeds, and grass roots. When winter comes, the frozen soil and the blanket of snow make a broad sheltering roof over the heads of many animals —earthworms, moles, some mice, chipmunks, and many insects. Beneath it, they spend the win-

A Red Squirrel in Its Winter Coat
It gains hairy ear-tufts; its back becomes rustier and it loses the black band that borders the light underparts in summer

ter, safe from dangerous cold. Most such animals prepare their winter homes and retreat into them before the ground freezes. Can you think of good reasons why?

Many of the short-distance travelers become dormant when they have moved into their winter quarters. We do not see them again until spring unless we find them in their shelters. Some are true hibernators, so completely inactive that they appear to be in a deep sleep. They need little oxygen, and their only food is supplied by fat stored in their bodies. In New York State, many insects, many reptiles and amphibians, and some mammals are hibernators, but no birds. Other dormant animals are "light sleepers." They rouse now and then, move about, perhaps eat a little, or even venture out on mild days. Still other short-distance travelers—some fish, for example—merely live a slow-motion life in winter.

Adults of many kinds of insects, spiders, and other small creatures die in autumn, or even earlier in the year. But, by the end of fall eggs or partly grown

young, such as caterpillars and grubs, insect pupae, and spiderlings are tucked away in various shelters. There they live through the winter, ready to become the adults of the next, or perhaps a later, year.

Mammals in Fall

Most New York State mammals are active all or much of the winter: opossums, moles, shrews, weasels, mink, foxes, muskrats, beavers, rabbits, deer, and some others. Most kinds are out and about except in heavy storms or extremely bad weather.

For most of these animals, fall changes are not great. Usually their coats grow thicker—a few change color. The rust- or red-brown summer coat of the white-tailed deer changes to grayish. Gray squirrels become more silvery, especially on ears and tail.

With the onset of winter, some mammals take up new quarters. Norway rats, house mice, white-footed mice, and red, gray, and flying squirrels often move into houses, barns, or garages. Outdoors, deer mice sometimes build a roof over and move into an old bird's nest. Red squirrels and gray squirrels often make special winter nests. Do you know any other mammals that sometimes move to new quarters or to sheltered places for winter?

Most of these hardy animals hunt food day by day—or night by night. The kind of food they seek puts them in two main groups: the vegetable-eaters or *herbivores,* and the animal-eaters or *carnivores.* Some—the opossum, for example—eat almost any food, plant or animal. We call such animals *omnivores.* As winter nears, favorite foods may grow scarce, and the animals may be forced to eat any suitable food they can find or capture, especially since they need even more food in cold weather than in warm seasons. Learn some animal tracks this winter. Every creature that ventures out on the snow writes a record of its activities. You will discover where some herbivores found food, and you may find where some carnivore captured an herbivore for a meal.

Only a few kinds of mammals gather and store food in autumn. Red squirrels and gray squirrels are two such animals. Perhaps if you watch you can discover some of their storage places, and some of the kinds of food they put into them. Have you discovered differences in what the two kinds of squirrels store, and where and how they store it? Have you ever watched a gray squirrel leaping over the snow,

stopping now and then to dig down for an acorn or a nut? Gray squirrels are active all winter; the red squirrel sometimes spends days at a time in its nest.

Have you ever come upon a little collection of empty cherry pits in a corner of the barn? A store of cherry pits may be somewhere close to your house right now, the work of a white-footed or deer mouse. When this mouse can add to its stores crumbs and other things stolen from the kitchen or barn, it can more easily get through the winter. But deer mice that live in the woods seem to find enough tender shoots, seeds, dried wild grapes, thornapples, and insects.

Field mice forage through the whole winter for green shoots, fresh bark, and roots. By the time spring comes field mice and rabbits often have done much damage in orchards by gnawing off the bark of young trees.

What can you learn about beavers' winter food?

All through the late summer and early fall the chattery little chipmunk gathers nuts, seeds, dried berries, and other things that will not spoil. By late September or early October each little fellow may have stored away as much as a bushel of tidbits in a warm dry nest underground. Chipmunks, fat and sleek, retire to their nests in November. Not much is seen of them again until spring. They may sleep for periods of a week or more, though theirs is not the deep "sleep" of the true hibernators, about which you may read next.

Mammals that hibernate have perhaps the most interesting way to survive the winter. They do not move away from it, nor put up with winter hardships. They just retire into winter homes, often somewhat protected from winter cold, and then they more or less ignore the season. New York State's most thorough hibernators are the woodchuck ("groundhog"), two kinds of jumping mice, and several kinds

A crow and a rabbit hunted food here

Photo by W. C. Barker

of bats. During summer and early fall, these animals eat more food than they need to keep them alive. The excess becomes thick layers of fat under their skins. Before autumn is half gone, most of these animals have retired to places where the temperature is fairly even, although it may be low. The woodchuck and the mice go into burrows in the ground, and the bats to caves. After a few drowsy naps, each finally falls into what appears to be a deep sleep. While they are hibernating, these animals barely move when they are touched. Their bodies are cold, too— just a few degrees warmer than their surroundings. They breathe only a few times each minute. They use little oxygen, and they can live through the winter with little or no food except their own fat. Some may lose almost half their weight before spring rouses them.

Raccoons, bears, and skunks, also grow fat in fall. They seek sheltered places at least in severe winter weather, and sometimes sleep for days at a time. They are not considered true hibernators, however.

Bats make longer fall migrations than any other New York State mammals. Like their relatives that hibernate, the migrant bats accumulate thick layers of fat under the skin. Most New York State bats hibernate, but the red bat, the hoary bat, and the silver-haired bat migrate southward.

Fall with the Birds

Autumn is migration time for many kinds of New York State birds. Some begin their journeys in early fall or even in midsummer, to places where they can obtain food and avoid excessive cold. Most of our summer residents have gone by November. A few robins, hermit thrushes, bluebirds, and others may still linger in sheltered places where food is available. Some may remain all winter in such places. Flocks of southbound birds from farther north pass through the State all fall.

The winter bird population consists mainly of birds that remain in the State all year (permanent residents, such as chickadees, white-breasted nuthatches, bluejays, and crows) and other birds from farther north that spend the winter here. By late fall this hardy group of land birds, shore birds, and water birds has settled into ways of life that help them live through the winter.

Food is their greatest need. They are active creatures. They need a large—and steady—supply

of food to keep active and to maintain their high body temperatures. Feathers are good insulation—they help to conserve the birds' body heat—but food is a constant need. Often winter birds make their homes where abundant food is available. Many turn to insect eggs, hibernating insects and other small creatures, seeds, dry fruits, and buds, as the supply of active insects and juicy fruits decreases. In so doing they destroy enormous quantities of weed seeds and harmful insects. Even these foods may become scarce. So, fall is an excellent time to erect bird feeders. *Inviting Bird Neighbors*, the Leaflet for Spring 1953, will help you with this problem.

Like the mammals, many winter birds move closer to places where people live. There they may find fruits on trees and shrubs, weed seeds in gardens, or insects or their eggs. Screech owls have been known to pass the winter in hay lofts, where they earned their rent by killing mice. The winter birds of prey, too, are likely to stay where the food supply is good.

In autumn many kinds of birds begin to travel in flocks. Companies of juncos, crows, starlings, and others feed and fly together during the day. They may roost close together at night. Watch

Photo by A. A. Allen

Chickadees hunt along branches and over twig tips for hibernating insects and insect eggs

for such flocks. When a flock moves, do stragglers stay behind long? When a company perches in a tree, are the birds likely to sit quietly, facing the wind, then all leave together? What advantage can you see in this behavior?

The favorite roosts of most land birds in winter are the "evergreens," the cone-bearing trees and shrubs. Flocks of birds, or sometimes individuals, may enter and leave such roosts almost as regularly as if they had some way to tell time.

Watch the birds around your home this evening. You may be surprised to see how many roost in nearby ornamental evergreens. Birds, such as woodpeckers, that nest in holes, usually roost also in holes. Ruffed grouse often roost in thick hemlocks, but they may dive into a snowbank for the night! Did you know that in winter little horny growths on their

toes help these birds to walk on deep snow?

Now, when most of the leaves are gone, is a good time to look for birds' nests. It is a good time to make a collection, too. Nesting time is past, and most birds (except hawks and owls) do not re-use old nests. Deserted nests are in better condition now than they will be later. The best ones to collect at first are those you watched in summer, when you could identify the birds that made them. For unknown nests, you will want to consult Dr. Allen's *Key to Birds' Nests,* listed on page 32.

When you collect, be sure to get the whole nest, and not to crush it or spoil its shape. You may need to remove with it the part of the branch to which it was fastened, and to tie it in place for the trip home. Cellophane-covered boxes make good containers—the nests can be easily seen, and they are protected from dust. Each nest should bear a label giving the name of the bird, where and when the nest was found, its height above the ground, and the finder's name. A neat collection is interesting and attractive. And to take apart a nest or two, and sort the materials of which it was made can give you a new understanding of the skill and industry of birds.

Animals with Changing Temperatures

When you are well, your temperature is normally about 98.6° F. It remains about 98.6°F. whether you are in a warm schoolroom or outdoors on a cold winter day. You are a *warm-blooded* or *constant-temperature animal*—your normal temperature is not changed by heat or cold around you. All mammals (you are one kind) and all birds are constant temperature animals, although their normal temperatures may not be the same as yours.

Snakes, frogs, fish, insects, and many other kinds of animals, however, are commonly known as cold-blooded animals although they might better be called *variable-temperature animals.* Their body temperature changes with that of their surroundings and never differs much from it. A frog, in warm pond water on a hot summer day, would have a body temperature about as warm as the water. The same frog, in a jar of ice water, would have a considerably lower temperature. You would see another change, too. As its temperature dropped, the frog would become less and less active.

In fall, as autumn weather be-

Praying Mantis and Her Egg-case
The adults die in autumn; young hatch in spring. Later this mantis ate the grasshopper shown faintly at lower right

comes cooler, the variable-temperature animals become more and more sluggish. Most of them finally enter some sort of winter home often out of reach of frost. There they hibernate or become more or less dormant until warm weather returns.

Snakes and Other Reptiles. Snakes do not wait for really cold weather to hibernate. While days are still warm they gather gradually at hibernating places that are often used year after year. They may spend a few days lying in the sun on sandy hillsides or on ledges and rocky places. Finally, they burrow deep into the soil or crowd into crevices and caves among the rocks. Usually they descend below the frost line, sometimes 3 feet or more. Large numbers may use the same burrow, often with their bodies intertwined in balls. Two or even more kinds may hibernate together.

Box turtles usually hibernate in soft soil in protected places, digging down as much as 2 feet. Wood turtles, spotted turtles, painted turtles, and some others dig down into the mud at the bottom of ponds or quiet stream borders. Most have disappeared by early November. Snapping turtles may remain somewhat active. Turtles are air-breathers, but they use so little oxygen in winter that they can live comfortably under ice-covered water.

The few kinds of lizards that make their homes in New York State hibernate.

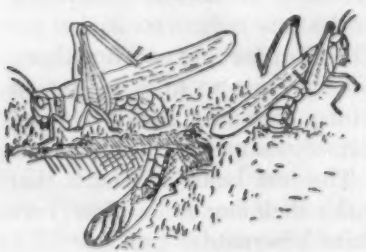
Frogs, Toads, and Salamanders. These animals spend most of their time in summer hunting for small creatures they eat. By early autumn, both young and adults have inside their bodies well-filled "fat bodies" which supply all the winter food most of them need. Through September they move toward their hibernating places, but it may be another month or more before some of them are tucked away for the winter.

Wood frogs, spring peepers, red efts, and several others of their relatives hibernate on land, under fallen leaves and other litter, beneath stones, in cavities in rotting logs, or in hollows between tree roots. Toads back into deep burrows, often in garden soil, and usually deep enough to escape freezing.

Leopard frogs, pickerel frogs, bullfrogs, green frogs, and several kinds of salamanders winter in brook and pond bottoms. There, too, are partly grown green frog and bullfrog tadpoles.

Toads and many others of this group of *amphibians* become completely inactive, but adult newts may eat, shed skins, and move about on brook bottoms and such places, even in midwinter. Some other water-dwellers are sluggishly active, also.

Grasshopper eggs, deposited in soil, live over winter; adults usually die



Fresh-water Fish. As lakes, ponds, and streams cool in autumn, many kinds of fish move to deeper water or to sheltered places. Most move more sluggishly than in warm weather, but some are more active than others. Some eat very little. Others feed fairly regularly, although they eat less than in summer.

Insects. Insects usually are abundant in September, but soon begin to decrease in numbers. Flies no longer gather on screen doors. Mosquitoes do not bother us. Butterflies disappear as the fall flowers fade. The insect chorus diminishes and finally is silenced. By late fall most kinds of insects have moved into winter quarters. Adults of some kinds have died. Only eggs or young of their kinds are still alive.

Insects have many ways to get through the winter. Most of them hibernate: as eggs,

Photo by Harvey Stork

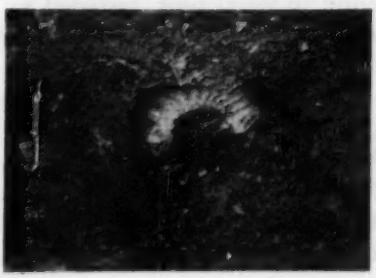
A moth caterpillar hibernates inside burdock burs

nymphs, larvae, pupae, or adults. (*Insect Homes*, the Leaflet for Winter 1953-54, will help you with these words.) Those that hibernate usually move down from their summer locations, closer to the ground or even beneath its surface. If they are water insects they move into deeper water or into the mud or among the rocks on the bottom. At first these insects may shift up and down with changing temperatures. Finally they settle down for the winter. Many do not need to go deep enough to escape frost—they can survive without doing so. Some hibernate alone, others in groups. Have you ever found a big company of lady beetles under loose bark, or lace-bugs in trash on the ground?

You can find hibernating land insects almost anywhere you choose to look: in soil, some deep down, some near the surface; among fallen leaves, dead grasses, and other plant litter; in rotting logs; under rocks or boards; on fences, walls, or bridges; around buildings, in crevices or under projecting ledges; inside buildings—houseflies, lady beetles, and some other insects choose such places; in weed tops and other low plants; on trees and shrubs, on or under the bark, in burrows in the wood, even hidden in winter buds; in galls and leaf mines; among roots, in seeds, fruits, and stems of many plants; in short, in almost any cranny anywhere that offers winter protection.

A few kinds of land insects remain active: bees in bee trees or hives; and insects in places kept

The white grub, larva of the May-beetle or June-bug, hibernates in soil, usually below frost line



The Pupa of the Tomato Worm in Its Earthen Cell

warm by man. Some water insects also are active, though most of them eat less and move more slowly than in warmer weather.

And, you remember, monarch butterflies migrate to the south.

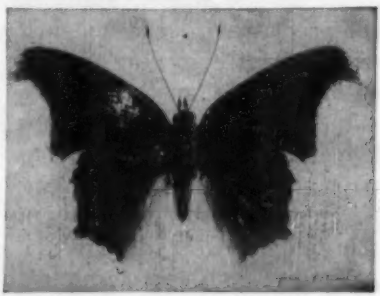
Spiders, Snails, Earthworms, and Others. During the fall months both adult and young spiders of some kinds hide away for the winter in small protected places. Adult spiders of other kinds die in autumn. Only their eggs remain, safely packed in silken cases of various shapes and sizes. These egg sacs are hung in weed tops, fastened in rolled leaves, to the bark of trees or to the undersides of stones, or hidden in other places. Tiny spiderlings may hatch within some egg sacs in fall or early winter, and remain there until spring, the stronger ones feeding on the others.

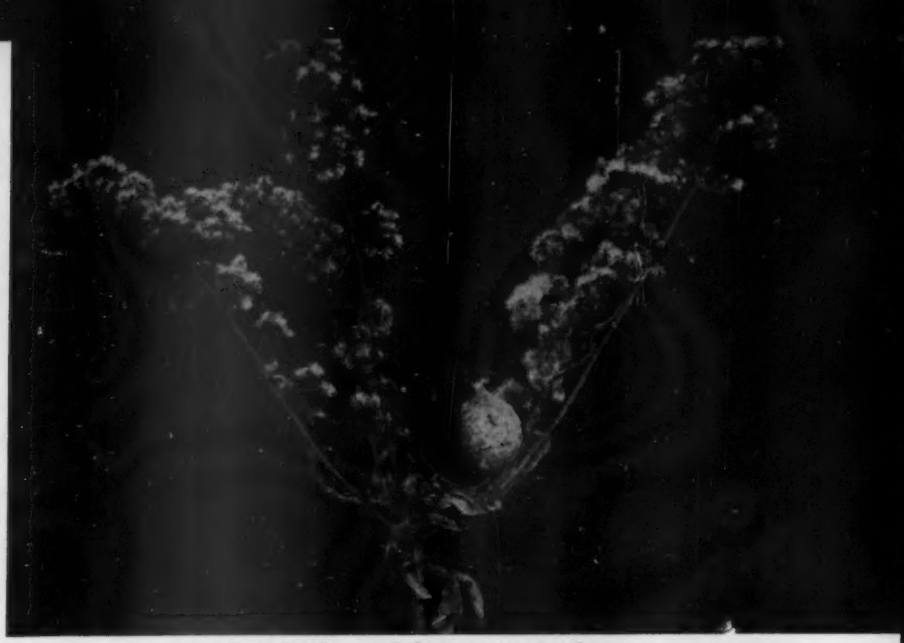
In October or November land snails and slugs go into hibernation in much the same kinds of places that shelter insects. Like insects, they can survive long periods of freezing. Water snails move to deeper water and sink to the bottom, where they may remain somewhat active if the water does not freeze, or may hibernate, frozen into ice and litter.

As the weather cools, earthworms burrow deeper and deeper into the soil. They spend the winter well below the frost line, often many together, in balls, their bodies intertwined.

Dozens of other backboneless creatures—crayfish, mussels, clams, leeches, centipedes, millipedes, sowbugs, and many more —go into hibernation in autumn, or, sometimes, especially if they live in water, remain more or less active.

The violet tip butterfly hibernates as an adult





Egg Sac of a Large Orb-Weaving Spider
The adults die in fall; the spiderlings may hatch inside the egg sac in winter

Some Things to Think About

Look back over the fall changes you have watched, and think about those discussed in this Leaflet. Do you think you understand better such things as the following?

Changes in climate bring changes in the air, water, and soil that make up our earth.

Those changes benefit or inconvenience us and every living thing around us. (Sometimes they do both.) Ice and snow, for example, may make travel by car difficult, but without them children could not skate, nor ski, nor build snow forts. Ice and snow may weigh down trees, but they are also insulators that help to shelter many plants and animals and to protect them from changing winter temperatures.

Sometimes fall changes in living things affect their surroundings. Fallen leaves and dead plants help to hold moisture in the soil, and often delay or even prevent the freezing of the soil beneath them. By their decay, these plant parts improve the soil and nourish new

generations of plants; and indirectly, new generations of animals.

But nothing that we or other living things have ever done has greatly affected the yearly changes in our climate. To these, we and other living things that live here must (and do) adjust, in one way or another.

Some Helpful Books and Pamphlets

So many subjects are considered in this Leaflet that it is difficult to choose references that you can use all through it. A few are listed on this page, as well as one or two of special interest. As usual, Cornell Rural School Leaflets of past years will be useful; also science textbooks and many library books. Many of the books listed in the Teachers' Leaflets for Fall 1953 and Fall 1954 are particularly helpful.

Field Book of Animals in Winter. By Ann H. Morgan. G. P. Putnam's Sons, New York City. 1939. 527 pages. Excellent for older readers.

Field Book of Natural History. By E. Laurence Palmer. McGraw-Hill Book Company, New York City. 1949. 664 pages. Much information about many plants and animals. For older readers.

Handbook of Nature Study. By Anna B. Comstock. Comstock Publishing Company, Ithaca, New York. 1939. 937 pages. Helpful information about common plants and animals.

In Woods and Fields. By Margaret Waring Buck. Abingdon-Cokesbury Press, New York City. 1950. 96 pages. Helpful pictures and easy-to-read information for younger readers.

Key to the Nests of the Common Summer-Resident Birds of Northeastern North America. By A. A. Allen. Slingerland-Comstock Company, Ithaca, New York.

The World Almanac and Book of Facts. Published annually by the New York World-Telegram and The Sun.

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